CASE REPORT OF HYDROXYAPATITE THERAPEUTICS IN THE ORAL REGION

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ABSTRACT

This paper presents a case report of hydroxyapatite therapeutics in the oral region. Apatite therapeutics in the oral region, i.e., clinical applications of sintered hydroxyapatite in treating oral diseases, involves not only the repair of defects in the skeletal structures of the jaw but, simultaneously, the facilitation of functional recovery by transplantation of artificial bones or roots of sintered hydroxyapatite. It is based on the transplantation of bioactive replacement materials for a mechanical-functional body, to which strong force is added, and is a treatment system encompassing high-grade dental and medical therapeutical techniques.

Teeth and bone are classified as mechanical supportive organ systems, and if the force added to these organs is appropriate, these organs are considered to possess a system that disperses the stress evenly so that forms and positions of these organs may change according to functional stress. Since a sintered hydroxyapatite block does not change its morphology biomechanically in response to the force added as in vital bone, built-in morphological harmony is important for the transplanted material. Sintered porous hydroxyapatite was applied in restoring the contour and supporting function of bone in order to treat various kinds of oral diseases. Favorable results were obtained.

INTRODUCTION

Hydroxyapatite therapeutics in the oral region was investigated. A case report resulting from our research is presented in this paper.

Clinical application of sintered hydroxyapatite to the treatment of disease in the maxillary and mandibular region is called apatite therapeutics in the oral region. This therapeutic method is accomplished by transplantation of artificial bones or roots of sintered hydroxyapatite.

Apatite therapeutics in the oral regions are classified as follows:

1) Reconstruction of the mandible or maxilla with sintered porous hydroxyapatite blocks.
2) Restoration of a bone defect with sintered porous granular hydroxyapatite after enucleation of a cyst in the mandible or maxilla.
3) Restoration of the alveolar process with sintered porous granular or block hydroxyapatite in alveolar bone resorption for other than denture-type prosthesis.
4) Restoration of the alveolar bone in marginal periodontal disease with sintered porous granular hydroxyapatite.
5) Application of sintered porous granular hydroxyapatite to autogenous tooth transplantation, replantation, or to surgical minor tooth movement.

6) Application of sintered porous granular apatite with apatite cement made of fine crystalline of hydroxyapatite for vital amputation of the dental pulp.

The masticatory apparatus can be defined as a digestive system with a skeleton. The skeleton is composed of the maxilla, the mandible, and the teeth (the denture in edentulous patients). The oral cavity has diverse functions to perform including important mechanical ones such as mastication, occlusion, and articulation. Sintered apatite can be applied to the defect portion of this skeletal system. The effective use of the biomaterial sintered hydroxyapatite, beginning with the treatment of the tooth-supporting jawbone, has resulted in improved mastication and occlusion as well as the restoration of the oral skeletal morphology. A porous artifical bone of sintered hydroxyapatite can restore a defect of the jawbone resulting from extirpation of cysts or benign tumors. It can save a tooth previously indicated for extraction and facilitate autogenous transplantation or replantation. In addition, artificial roots of compact sintered hydroxyapatite can effectively be used for a small number of missing teeth.

The tooth and bone can be classified as supportive mechanical organs (ATSUMI). One unique feature of mechanical organs is that a mechanical structural defect or a morphological anomaly can lead to disease. The fact that minor structural defects in the dentition, such as diastema, crowding, tooth irregularity, rotation, and traumatic occlusion, can lead to periodontal disease which results in the detachment of the root surface and periodontal tissue. This detachment results from the pressure of food impaction during mastication in conjunction with bacterial action. When protrusive and lateral movement of the mandible are restricted by a structural defect in the dentition, functional deviation of the jaw can occur. This, in turn, results in condyle head impairment, causing temporomandibular joint disorders. Therefore, these structural defects must be restored prior to apatite therapeutics. The application of biomaterials in the oral region demands an integrated approach involving a working of endodontics, periodontal surgery, and restorative dental procedure including full bridges with the use of keyways. Thus, it requires a therapeutic approach with regard to the oral cavity as a whole organ system. Reconstruction of oral skeletal defects should be attempted only with a mastery of basic surgical procedures and principles of biomaterial transplantation. In addition, it is necessary to thoroughly understand the characteristics of the system of bones and teeth.

CASE REPORTS

1) Case Report 1. (Figures 1-6). A 48 year old male with buccal cyst after a maxillary sinus operation. The cyst was marsupialized, and drainage was established with a plastic plug. After the cyst shrinking below the maxillary bone, apatite therapy was initiated.

Figure 1: Radiograph immediately after marsupilization with radiopaque material.

Figure 2: Radiograph with sintered hydroxyapatite granular artifical bone, 24 months postop. Once the cyst shrinks below the maxillary bone, apatite therapy can be initiated.

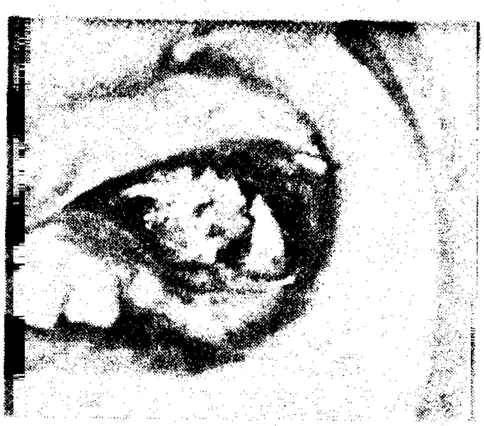

Figure 3: The cystic wall was complete extirpated.

Figure 4: The cystic cavity with full coagulation.

Figure 5: Larger apatite granules were applied to the cortical area.

Figure 6: Photo, 2 years postop. Three artificial roots were implanted in this region 2 years after the operation.

2) Case Report 2. (Figures 7-12). A 50 year old male with severe periodontitis. The affected tooth was extracted and reimplanted with sintered apatite granules after the alveolar socket was deepened with a surgical bur.

Figure 7: Preop photo. The teeth were fixed with wire. Pathological gingival pocket formation 9 mm in depth was around the tooth.

Figure 8: Photo during operation procedure with apatite granules. The bottom of the extracted socket was drilled.

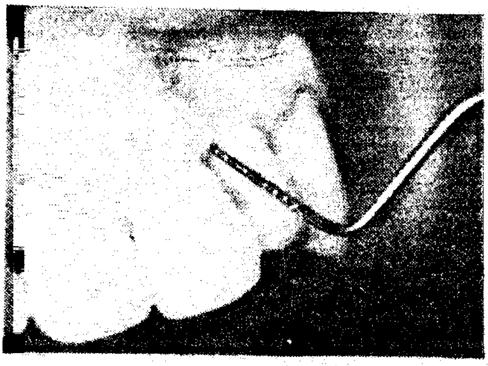

Figure 9: Photo 3 years postop. Pathological pocket has turned sulus 1 mm in depth.

Figure 10: Preop radiograph of the affected tooth.

Figure 11: The affected tooth was extracted once, and the root surface was ground to expose the intact dentine.

Figure 12: Radiograph, 3 years postop.

DISCUSSION

It is generally accepted that transplant operations on mechanical supportive organs such as bone can be performed with very safe and easy procedures. Common medical knowledge of biomaterial transplantation dictates the following basic principles:

1) Inflammation should not be present at the transplantation site.
2) The transplant should be fixed and maintained in the operation site until complete recovery is achieved.
3) Complete closure of the wound should be assured to prevent infection.

In the oral regional there are many cases of apatite therapy in which these three principles cannot be applied because of its functions of mastication and articulation with strong force. Especially, the application of sintered porous hydroxyapatite granules to periodontal disease is contraindicated from the point of common medical practice. The criteria for the biocomposition of the transplanted biomaterials (implants) are as follows:

1) Stabilization in the operation site to prevent movement of the implant.
2) Prevention of infection around the implant.
3) Supply of nutrients to the tissues surrounding the implant by means of blood vessel formation.

From the oral function point of view, it is quite difficult to follow these three criteria postoperatively until the transplant materials have biocomposed. A protective device is necessary for stabilization of the operation site near the teeth, and intravenous administrations of antibiotics are required even for a small transplant operation. A blood supply is indispensable for the inorganic sintered hydroxyapatite. Therefore, in some cystic diseases in the jawbone, cortical bone of the cystic wall should be perforated to obtain a blood supply from the bone marrow. Sintered apatite should be immersed in blood at first and not in physiological saline solution as is commonly practiced. Sintered apatite has a very important anticoagulation property, i.e., absorption of the blood coagulation factors. Therefore, sintered apatite granules should be applied to wounds which are full of coagulants. Without coagulants, sintered hydroxyapatite granules cannot be biocomposed. With fresh blood, in the case of large wounds, however, the operation site will be extremely swollen from internal bleeding for the sake of anticoagulating properties of hydroxyapatite. Therefore, a practical approach must be taken in oral apatite therapeutics. Using this practical approach, sintered hydroxyapatite can be applied even to a contraindicated case of progressive periodontitis.

It is common knowledge that mechanical supportive organs such as bones are characterized by morphological changes in accordance with function. This was discovered by Culmann and von Meyer about 120 years ago while observing a femur cross-section. One hundred years ago, Wolff, after whom Wolff's Law was named, theorized that bone morphology and trabecular formation depend on the force applied. These findings shed light on the fact that an organ of the masticatory apparatus is characterized by the close relationship between oral-perioral habits, jawbone morphology, and tooth alignment. To utilize artificial bones and roots effectively, a working knowledge of basic surgical procedures is a requirement along with the understanding of the relationship between structural defects of the dentition and disease. Basic surgical procedures and the principles concerning biomaterial transplantation must be fully understood by the operator. Unlike placement in other areas, here the apatite is used as a skeletal replacement for the oral digestive system. As the transplanted material is placed directly under the highly mobile gingiva and periosteum, it is more prone to bacterial infection. Therefore, in the oral cavity, apatite is exposed to an extremely inhospitable environment, making various contrivances necessary for its use.

As the morphology of a supportive mechanical organ changes with function, long-term oral habits can frequently affect the dentition and morphology of the jawbone and mandibular joint, giving rise to structural defects and morphological change. Typical habits of the oral and perioral regions include mouth breathing, tongue manipulating, unilateral masticating, hand resting, thumb sucking, and pillow positioning, among others. All these factors can affect the dentition and jawbone morphology, thereby causing structural defects and morphological changes. These habits can influence the outcome and success of biomaterial transplantation procedures. As such, diagnosis and correction of such habits, if any, should be considered an important component prior to every treatment involving these biomaterials.

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